12. The average positive value of y_3 is normally 5.0, and the average negative value of y_3 is normally 4.7.

TABLE 1

Month	Air normals			Water normals		
	Observed values	Calculated from equation	Difference	Observed values	Calculated from equation	Difference
	(a)	(b)	(a-b)	(c)	(d)	(c-d)
January	−6.4	−6.4	0.0	1.0	0.8	0.2
February	−5.4	−4.7	−.7	.0	.0	.0
March	1.1	−.2	1.3	.9	.8	.1
April	5.9	6.0	−.1	3.1	3.1	.0
May	11.2	12.2	−1.0	6.5	6.2	.3
June	15.1	16.7	−1.6	8.9	9.3	−.4
July	18.4	18.4	.0	11.6	11.6	.0
August	17.3	16.7	.6	12.4	12.4	.0
September	13.9	12.2	1.7	12.1	11.6	.5
October	8.5	6.0	2.5	10.2	9.3	.9
November	3.1	−.2	3.3	7.1	6.2	.9
December	−3.4	−4.7	1.3	3.5	3.1	.4

TABLE 2

Month	Observed values			Calculated values, y_3
	y_1	y_2	$y_3=y_1-y_2$	
January	1.0	−6.4	7.4	7.2
February	.0	5.4	5.4	4.7
March	.9	1.1	−.2	1.0
April	3.1	5.9	−2.8	−2.9
May	6.5	11.2	−4.7	−6.0
June	8.9	15.1	−6.2	−7.4
July	11.6	18.4	−6.8	−6.8
August	12.4	17.3	−4.9	−4.3
September	12.1	13.9	−1.8	−.6
October	10.2	8.5	1.7	3.3
November	7.1	3.1	4.0	6.6
December	3.5	−3.4	6.9	7.8

A REMARKABLE OCCURRENCE OF CYCLONES IN SERIES

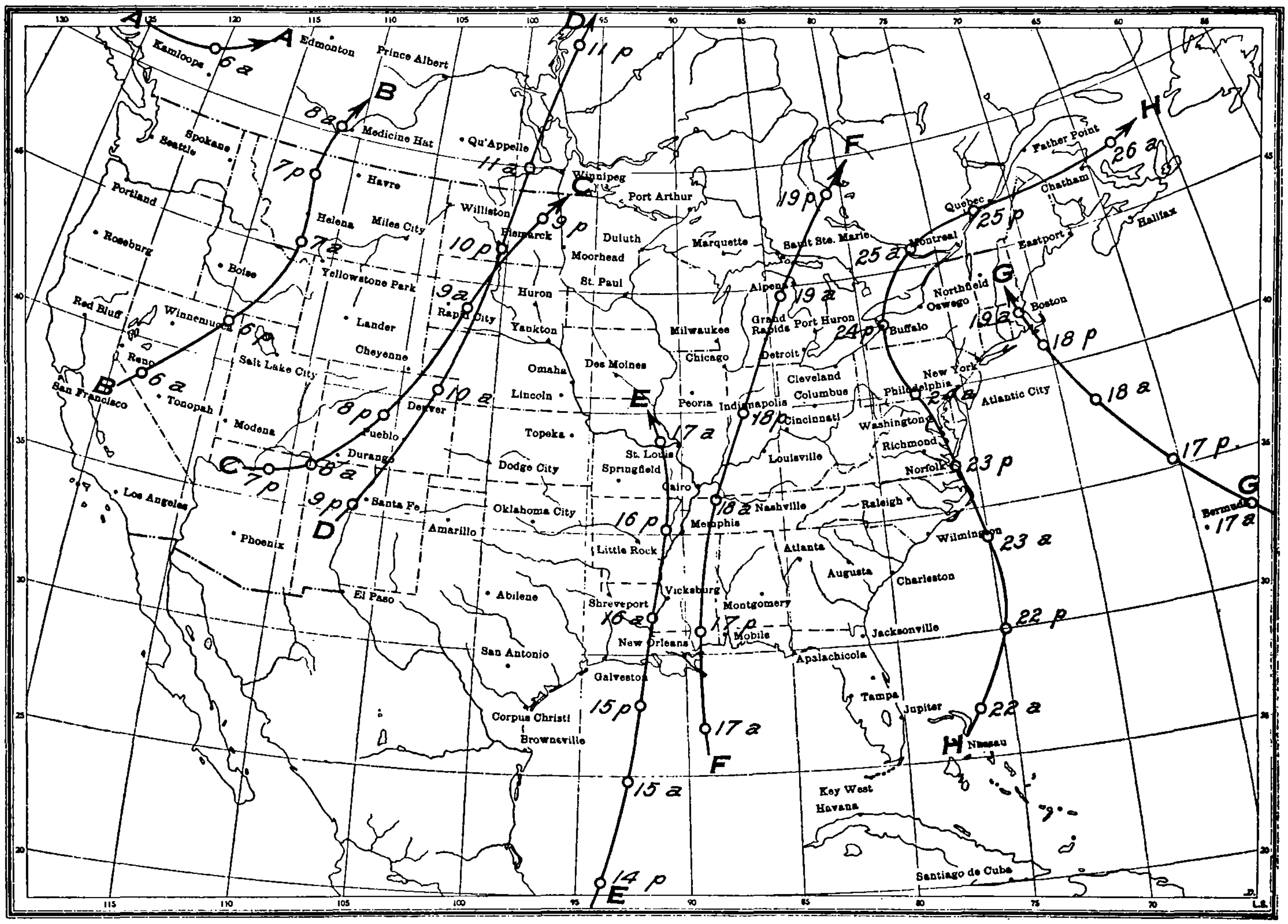
By EDWARD H. BOWIE

[Weather Bureau, San Francisco, Calif., September 1933]

The occurrence of cyclones in series is a phenomenon with which all those having to do with the preparation of synoptic charts are more or less familiar. In the Bjerknes frontal theory such a series is designated a *cyclone family*.

In an article on "The Planetary System of Convection", by William R. Blair, in the MONTHLY WEATHER REVIEW, April 1916, vol. 44, p. 194, one finds the following:

Some years ago Mr. E. H. Bowie called the writer's attention to the fact that the low-pressure areas enter and cross the United States in series. The first low-pressure area in such a series will enter the country well to the north and pursue a course eastward over the northern States; the second enters somewhat farther south, and so on. The last low-pressure area of the series may enter the extreme southwest, and pass along the Gulf and Atlantic coasts, although the series do not always carry as far south as this. The series follow each other in close succession. The relation between



Tracks of cyclones in the United States during October 1923.

these series of low-pressure areas and the general meridional movement of the atmosphere seems to be quite direct. The fact that the low-pressure areas of any series pursue more nearly the same path across the Atlantic than they have pursued across the continent seems to indicate that the change in position of the thermal equator occurs mostly over land areas. It is possible that the meridional motion found over the continental area is compensated by a meridional motion in the opposite direction of [*over*] the oceans.

It is a fact that the cyclones of the North American Continent often occur in series. The first storm of each series runs its course far to the north, and each succeeding one farther and farther south and east usually until the entire continent is passed, after which any subsequent member of the series forms over the Atlantic Ocean.

It should not be understood that the places of first appearance of the cyclones in successive groups are the same, but only that there is a tendency for the subsequent disturbances of a series to run farther to the south and east following the occurrence of the first, a fact that may be verified times almost without number by referring to the charts in the MONTHLY WEATHER REVIEW that show the chronological records of the tracks of cyclones.

Of all the charts of this kind examined, that of October 1923 best illustrates the tendency of cyclones of the North American Continent to occur in series. This chart of October 1923 is here reproduced in somewhat modified form to bring out the cyclone series of that month in a more detailed way. The first of the cyclone tracks of the series shown is designated *A*, and it lies over British Columbia. Its life on the continent was short, as it was charted for only one observation, that of the morning of the 6th. The second track, designated *B*, starts over Nevada and ends over southern Alberta. The third, *C*, begins over Arizona and ends over northeastern North Dakota. The fourth, labeled *D*, begins over New Mexico, and being long-lived, ends in the region of Hudson Bay. The *E* track begins over the southwest part of the Gulf of Mexico and ends over Missouri, and the *F* following the *E* also begins over the Gulf of Mexico and ends over Ontario; *G* begins in the vicinity of Bermuda and ends near Cape Cod, while the *H* track begins to the southward of Cuba, crosses the coast line near Cape Hatteras, and ends near the mouth of the St. Lawrence River. The *H* track completes the series as far as the North American Continent is concerned. Possibly its continuance on the North Atlantic Ocean could be followed, but the material with which to do this is not available to the author.

An inspection of the chart of cyclone tracks in the MONTHLY WEATHER REVIEW for October 1923 shows that at the time cyclone *F* was forming and passing northward from the Gulf of Mexico, the first cyclone of a new series had appeared in Saskatchewan, followed by the formation of a second of the new series over Nevada and later a third of the series over the upper Rio Grande Valley. Thus it would appear that all of the cyclones of October 1923, between the 6th and the 31st, belonged to two series, the first of which began with *A* on the 6th in British Columbia and ended with *H* on the 26th in the St. Lawrence Valley. The equal of this interesting series is not to be found in the MONTHLY WEATHER REVIEW charts of cyclone tracks for months previous to and following October 1923, although many interesting series are preserved in these charted records.

FOG FORMATION AND DISSIPATION IN THE OKLAHOMA CITY AREA, 1920 TO 1931, INCLUSIVE

By PERRY O. EPPERLY
[Weather Bureau, Oklahoma City, Okla., October 1933]

Fog is most frequent in the Oklahoma City area in January and most lasting in February. An average of 44 hours of fog may be expected in January with an

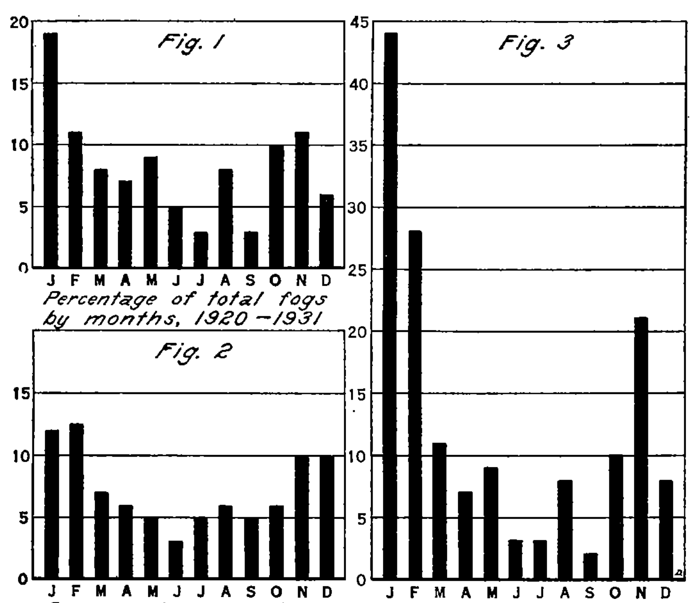


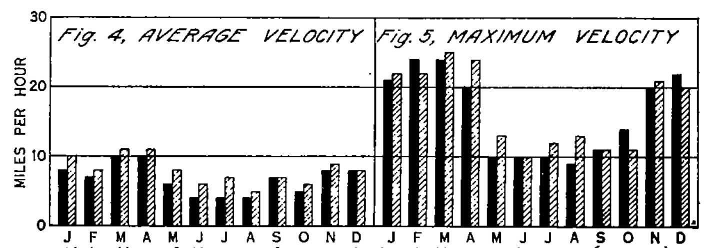
Fig. 1. Percentage of total fogs by months, 1920–1931

Fig. 2. Average duration of fogs in hours, 1920–1931

Fig. 3. Average number of hours of fog by months, 1920–1931

average duration of 12 hours. In unusual cases fog has continued with very little variation in intensity for 64 hours. Usually, however, it does not last more than 12 hours. The average number of fogs per day and the average duration of each fog gradually decrease as summer approaches. The minimum average duration is in July and is not more than 3 hours.

The duration, frequency, and intensity of fog are largely regulated by pressure, temperature, and humidity, though wind direction, sky conditions, and convection



Velocity of the surface wind at the beginning (black) and the ending (shaded) of fog, 1920–1931

currents play an important part in fog formation and dissipation in this area.

On an average, fog formation occurs when the pressure is steady to rising slowly, temperature falling slowly, and the dew point rising slowly to rapidly. These factors, pressure, temperature, and dew point, tend to remain steady for the duration of the fog.

Variations in the temperature and pressure act directly on the humidity, and cause changes in the density of the fog. A shift of the wind from either south or north to easterly usually intensifies the fog and increases its duration, while a shift to westerly in almost all cases